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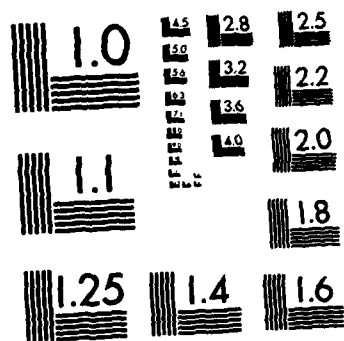
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TECHNICAL REPORT

ABSTRACTS OF RESEARCH PROJECT REPORTS BY NATIONAL NAVAL DENTAL
CENTER FIRST-, SECOND-, AND THIRD-YEAR RESIDENTS - JUNE 1982

by

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and
H. N. HUGHES

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ADMINISTRATIVE INFORMATION

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ABSTRACT

These abstracts provide a synopsis of research projects conducted by dental officers enrolled in the first-, second-, and third-year residency programs at the National Naval Dental Center, Bethesda, Maryland, during the academic year 1981-1982. The projects were completed in partial fulfillment of the requirements of the programs.

The opinions and assertions contained in these abstracts are the private ones of the writers and are not to be construed as official or as reflecting the views of the Department of the Navy.

Studies involving human subjects were conducted with the approval of the Committee for the Protection of Human Subjects.

Studies involving animal subjects were conducted according to the principles set forth in the Guide for the care and use of laboratory animals, Institute of Laboratory Resources, National Research Council, DHEW, Pub. No. (NIH) 74-23.



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Species

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ABSTRACTS OF FIRST-YEAR REPORTS

No. 1

THE CASTABILITY OF VARIOUS BASE METAL ALLOYS UTILIZING THE GAS-OXYGEN HAND TORCH TECHNIQUE

R. A. Brunhofer and M. P. Larson

High temperatures are required for casting base metal alloys. The gas-oxygen torch offers a readily available, inexpensive method of achieving this goal, but few studies have been reported on its use in casting base metal alloys. The purpose of this study was to evaluate the castability of base metal alloys when the gas-oxygen hand torch was used. Five popular base metal alloys (Rexillum III, Co-Span, Unibond, Ceramallooy II, Neydium) and a Type III gold alloy (control) were evaluated. Castability was determined by using the test pattern technique of Whitlock et al. The test pattern was a No. 18 polyester sieve cloth with a grid containing 100 open squares and 200 segments. Test patterns were cast with five samples of each alloy. The number of complete cast segments in each test pattern was counted and a percent castability value was calculated. The castability values were 100 percent for the control, Rexillum III, and Co-Span; 92 percent for Unibond; 88 percent for Ceramallooy II; and 35 percent for Neydium. In terms of castability, only Ceramallooy II and Neydium differed significantly from the control ($P < .01$, Student *t* test).

No. 2

AN EVALUATION OF THE THERMATIC COMPACTION TECHNIQUE OF CONDENSING GUTTA-PERCHA FOR HEAT PRODUCTION

W. J. Dollard

The McSpadden compactor technique is a relatively quick, efficient means of obturating root canals, but the heat produced by the compactor might damage the periodontal ligament and cause volumetric changes in gutta-percha. No studies have been reported to document the temperature produced in the root canal by the compactor. The purpose of this study was to measure the amount of heat produced during thermatic condensation of gutta-percha with the McSpadden compactor. Eight previously extracted single-rooted human teeth were used. Each tooth was prepared for obturation and then split in half longitudinally. Horizontal grooves were made in the canal wall at levels of 2, 4, 6, and 8 mm from the apex of the tooth. Thermocouples were placed in the grooves, flush with the canal wall, and the halves of the tooth cemented together. The thermocouples were attached to a continuous-strip recorder to measure the temperature at each level. Four teeth were obturated with the McSpadden technique, and as a control, four teeth were obturated with the conventional warm gutta-percha technique. The mean temperatures produced in the canals during obturation with the McSpadden technique ranged from $45.7^{\circ} \pm 3.6^{\circ}$ C at the 2-mm level to $72.6^{\circ} \pm 9.2^{\circ}$ C at the 8-mm level. There were no significant differences ($P > .01$, Student *t* test) between the mean canal temperatures produced by the McSpadden and the control obturation techniques at any levels.

No. 3
A DETERMINATION OF PLASMA CATECHOLAMINE CONCENTRATION
ASSOCIATED WITH THE ADMINISTRATION OF LOCAL ANESTHETIC AGENTS
CONTAINING EPINEPHRINE

C. D. Ferguson

Although much has been written about the potential hazards of using local anesthetics containing epinephrine, there is still a great deal of confusion about the actual effect of such anesthetics on hemodynamics and the sympathetic nervous system. The purpose of this clinical study was to evaluate the effect on mean arterial pressure (MAP), heart rate (HR), and plasma epinephrine (E) and norepinephrine (NE) of mandibular block anesthesia produced by lidocaine anesthetic solutions with and without epinephrine. Ten healthy men, with a mean age of 35 years, were evaluated in a randomized double-blind crossover manner. MAP and HR were measured and blood samples were collected 20 and 30 minutes before the anesthetic was administered and 1, 2, 4, 8, 16, 30, and 60 minutes after administration. Anesthesia was achieved with a 1.8-ml cartridge containing either lidocaine 2 percent or lidocaine 2 percent with 1:100,000 epinephrine. Compared with the baseline values, lidocaine alone caused no significant changes ($P > .05$) in MAP, HR, or plasma E and NE at any time period, whereas lidocaine with epinephrine caused a significant increase ($P < .05$) in plasma E at each of the time intervals up to 60 minutes after injection, and a significant increase ($P < .05$) in HR for only the first 2 minutes after injection. Lidocaine with epinephrine caused no change in MAP or plasma NE. These results show that lidocaine with epinephrine causes an increase in plasma E, but the hemodynamic response is minimal in healthy persons.

No. 4
A STUDY ON THE SOFTENING OF GUTTA-PERCHA
IN CHLOROFORM AND EUCALYPTOL

M. D. Hickey

Eucalyptol has been suggested as a possible replacement for chloroform to soften gutta-percha cones. At room temperature, however, eucalyptol takes considerably longer than chloroform to soften gutta-percha cones. The use of eucalyptol would be clinically practical only if its softening properties could be increased. The purpose of this study was to compare the effect of heat on the softening properties of eucalyptol and chloroform. Thirty No. 50 gutta-percha cones were tested. Each cone was held with endodontic locking forceps and the tip of the cone was lowered about 15 mm into the test solution. Softening time was determined as the time from immersion of the cone until the tip of the cone completely separated from the main body. Five cones were immersed in chloroform and five in eucalyptol at temperatures of 22° C, 37° C, and 50° C. The results showed that the softening properties of both agents generally increased as the immersion temperature increased. For cones immersed in chloroform, the softening time was 1 min 28 sec at 22° C, 1 min 16 sec at 37° C, and 59 sec at 50° C. For cones immersed in eucalyptol, the softening time was 20 min 46 sec at 37° C and 10 min 11 sec at 50° C. The tips of cones immersed in eucalyptol at 22° C had not softened sufficiently to separate from the bodies

at 60 min. These results show that heating eucalyptol above room temperature does increase its softening properties, although it still takes considerably longer to soften gutta-percha cones with eucalyptol than with chloroform. Despite these longer softening times, eucalyptol must be considered as a likely alternative to chloroform in the event that chloroform is proven to be a carcinogen in man.

No. 5

A CLINICAL EVALUATION OF IRRADIATED FREEZE-DRIED SKIN ALLOGRAFTS IN HUMANS

H. T. Hickson

The routine use of freeze-dried skin (FDS) allografts is limited because of possible allergic responses to antibiotics that may remain in the tissue after sterilization. Irradiated freeze-dried skin (IFDS) has been proposed as a remedy for this problem, but there are few studies on the clinical efficacy of IFDS allografts. The purpose of this study was to compare FDS and IFDS allografts in humans for shrinkage, graft acceptance, mobility, esthetics, and postoperative discomfort. Eight subjects were used: Six subjects received paired FDS and IFDS allografts, another subject received one FDS allograft, and another subject received four IFDS allografts. Data were collected pre-operatively, immediately postoperatively, and 1, 2, 4, 12, and 24 weeks post-operatively. At 24 weeks, all 17 allografts were present. There was a mean shrinkage of 55 percent for FDS and 64 percent for IFDS allografts, not a significant difference ($P > .01$, Student t test). Five FDS and five IFDS allografts were mobile; three FDS and two IFDS allografts were unesthetic. Subjects with paired allografts reported mild-to-moderate postoperative discomfort at both sites. When data for graft acceptance, mobility, esthetics, and postoperative discomfort were compared, there was no significant difference ($P > .01$, chi-square analysis) between FDS and IFDS allografts. Our results suggest that IFDS can be substituted for FDS with no difference in clinical results.

No. 6

THE EFFECTS OF POSTERIOR INTERPROXIMAL CONTACTS ON PERIODONTIUM

J. L. Hilgeman

Studies relating contact integrity and periodontal status are conflicting. Few reports address the integrity of the interproximal contact and its associated periodontal condition. Of the studies done, a number are limited to a relatively youthful population. The purpose of this study was to investigate interproximal contact strength and its associated periodontal condition in an older population. Subjects were selected from patients and staff at the National Naval Medical Center and the National Naval Dental Center, Bethesda, Maryland. Those selected were divided into two age groups: 30-40 years and 50 years or older. Examinations of the posterior interproximal areas were conducted to determine gingival inflammation, probing depth, loss of attachment, presence of calculus, food impaction, restorations and overhangs, carious lesions, plaque indexes, and contact integrity. One examiner performed all the evaluations. The examiner was trained in evaluation procedures so that there was a 90 percent or better agreement with another periodontist. With the study

about half completed, 55 evaluations have been conducted: 20 of the younger group and 35 of the older group. Preliminary results revealed that open contacts demonstrated the least amount of attachment loss and that loose contacts demonstrated the greatest probing depth. Additional data will be collected and the results statistically analyzed to validate these preliminary findings.

No. 7

LATERAL CURING WITH A VISIBLE-LIGHT-ACTIVATED RESIN

R. W. Huggins

Visible-light curing systems offer several advantages over ultraviolet-light curing systems, but no studies have been reported on the extent to which visible-light systems cure into undercut areas, either directly through tooth structure or indirectly by lateral polymerization. Incomplete polymerization of material in undercut areas could lead to pulpal irritation and compromised retention. The purpose of this study was to evaluate lateral polymerization of a visible-light-activated composite resin material (Prisma-Fil) in extracted human teeth. A standard preparation was made in the outer surface of 30 extracted teeth. The preparation consisted of an initial cylindrical cut 2.0 mm in diameter through the 3.0-mm thick, longitudinally cut section. From this initial cut, two small extensions 1.0 mm in width, length, and depth were cut in dentin on the inside surface 2.0 mm from the enamel surface and lateral to the main cylindrical preparation. The composite resin was then placed in the rejoined sections, which were cured with the visible-light source for exposure times of 10, 20, or 30 seconds. The degree of cure was determined by measuring the hardness of the lateral extensions and the center of each cylindrical core (control) with a Knoop hardness tester. No data have been collected at this time because of technical difficulties encountered in the standardization of tooth preparation for measurements on the hardness tester. The study is continuing in an effort to resolve these problems.

No. 8

PULPAL RESPONSE TO REPEATED ELECTRICAL PULP TESTING

J. H. Isaacson

In difficult diagnostic cases, teeth may be pulp tested several times within a relatively short period. The procedure may change the pain threshold so that a true response is not actually determined. A study was undertaken to examine this response to repeated electrical pulp testing. Twenty subjects with bilateral nonrestored maxillary cuspids were selected. All the test teeth were air-dried, isolated with cotton rolls, and pulp tested with a digital pulp tester (Model 2001, Analytic Technology). Twenty right or left maxillary cuspids were tested in alternate subjects, with the contralateral tooth serving as the control. Each tooth in the experimental group was pulp tested five times, with a 1-minute interval between tests. The control teeth were tested twice, before and after the experimental teeth, with approximately an 8-minute interval between tests. Mean threshold values were calculated for each interval and statistically evaluated with the Student t test. Results showed no significant changes in pulpal thresholds in either the experimental or control groups. Under the conditions of this study, repeated electrical pulp testing did not significantly alter pulpal thresholds in maxillary cuspids of human subjects.

No. 9
EVALUATION OF MICROLEAKAGE IN A DENTIN-BONDING SYSTEM

R. F. Kuhel

The failure of many Class V composite restorations is due to leakage at the gingival margin. New products claiming to have superior dentinal bonding characteristics are constantly being introduced into dentistry. The purpose of this study was to evaluate a dentin-bonding and restorative system for marginal leakage in extracted human teeth. Class V cavity preparations were cut to locate the gingival margin on the root surface. Sixty teeth in the experimental group were etched with citric acid followed by the application of a drying agent and a dentin-bonding agent. Eighteen teeth in the control group were treated in the same manner, except that the dentin-bonding agent was omitted. All preparations were coated with a diluent resin and restored with the recommended composite material. The teeth from the experimental and control groups were stored in water at 37° C for 24 hours, 3 weeks, or 6 weeks and then thermocycled alternately between 55° C and 5° C. All the restorations were stained with silver nitrate, sectioned, and graded for leakage. There was no significant difference in leakage between restorations placed with and without the dentin-bonding agent. Combined results showed leakage on the pulpal wall for 92 percent of all restorations. Only 4 percent showed no leakage, and an additional 4 percent showed staining along the gingival wall.

No. 10
THE EFFECT OF A 0.2-PERCENT SnF_2 MOUTHRINSE ON
GINGIVAL TISSUES AND ASSOCIATED MICROFLORA

L. Larson

A 5-month double-blind crossover clinical study was conducted to evaluate the effects of a commercially available 0.2-percent SnF_2 mouthrinse. Twenty-four young adults (mean age 25 years) participated. Six sites with a Gingival Index (GI) of 2 or 3 were evaluated in each subject. There were two experimental 2-month periods during which the subjects rinsed daily with a mouthrinse and a 1-month interim period of no rinsing. During the first experimental period, half the subjects used the SnF_2 mouthrinse and half used a nonfluoridated mouthrinse. This rinsing schedule was reversed during the second experimental period. All subjects performed their usual oral hygiene procedures. Data were collected from each gingival site for bleeding tendency after plaque collection, the GI, and phase-contrast microscopic assessment of bacterial motility. Plaque samples were collected by passing a round wooden toothpick no deeper than 2 mm subgingivally at each site. Evaluation of the results demonstrated a significant decrease in bleeding tendency with the daily use of the 0.2-percent SnF_2 mouthrinse. No significant effect was noted on the GI or the bacterial motility. There appears to be a limited beneficial effect with the daily use of a 0.2-percent SnF_2 mouthrinse.

No. 11
THE EFFECT OF SETTING EXPANSION UPON THE MOLD CAVITY
VOLUME WITHIN PHOSPHATE-BONDED INVESTMENTS

F. Marsaw

The setting expansion of three commercially available phosphate-bonded investments was determined by measuring the change in volume of a cavity located in the center of the investment. A water-filled reservoir with a volume of 1.2 ml was connected to a 0.1-ml pipette (0.3 mm in diameter) and embedded in the center of the casting investment. Changes in the volume of the reservoir resulted in changes in the water level in the pipette. The internal temperature of the investment was monitored by a thermocouple. This experiment was performed with both nonyielding metal and yielding rubber casting rings. Volumetric measurements for each of the three investments tested yielded mean linear setting expansions (LSE) of 0.57 percent \pm 0.08 percent (n=14), 0.56 percent \pm 0.10 percent (n=13), and 0.39 percent \pm 0.08 percent (n=10). The LSE of the investments was also determined according to the trough method of ADA Specification No. 2; these measurements agreed with data provided by the manufacturers all in the order of 1.0 percent. The values for setting expansion obtained in the center of the mold by the volumetric method were only half as large as the values derived externally with the ADA's trough method. The results for metal and rubber casting ring samples were indistinguishable. These findings indicate a need to reevaluate the presently accepted mechanism for setting expansion.

No. 12
ENDOTOXIN RECONTAMINATION FOLLOWING
ROOT PLANING IN VIVO

F. Martinez, Jr.

Endotoxin is a biologically active substance with periodontopathic potential. Although root surfaces exposed to periodontal disease have been shown to contain cementum-bound endotoxin, vigorous root-planing procedures are usually effective in removing most of the endotoxin. However, the rate of recontamination of previously scaled root surfaces with endotoxin has never been reported. The purpose of this study was to quantify endotoxin recontamination with the limulus amebocyte lysate test. The study was designed to include three posttreatment groups of 0, 10, and 30 days, with 25 teeth pooled for each group. The pooled endotoxin samples obtained from each group will be analyzed for endotoxin content according to the procedures outlined by Nishimine and O'Leary. To date, approximately 40 percent of the samples have been collected. Additional testing is in progress to ascertain the efficiency of extraction of endotoxin from root surfaces.

No. 13
THE EFFECT OF TAPERING ON WROUGHT WIRE FLEXIBILITY

E. A. Monaco

The combination wrought wire clasp is historically considered advantageous because of its flexibility, adjustability, and appearance. Tapering has been recommended as a method of improving clasp flexibility, stress distribution, and contour, but there are no published reports evaluating the types of taper and the physical properties of tapered wrought wires. The purpose of this study was to evaluate the effect of tapering on the flexibility of wrought gold and base metal alloys. Partial and full tapers were evaluated on 18- and 19-gauge Ticonium wrought wire, Ney PGP wrought wire, and Jelenko Super Wire. Untapered 18-, 19-, and 20-gauge samples of these wires served as controls. The amount of taper employed for each material was determined from clinical judgment and published flexibility values. Tapering was accomplished manually by a bench lathe with a mounted 100-grit grinding wheel. All samples were measured for dimensional accuracy. Wire clasps 12 mm long were contoured in a single plane to a standard die and soldered to a test plate. Flexibility was tested with an Instron universal testing machine. The flexibility of the partially tapered wrought-wire samples did not differ significantly from that of the untapered controls. Similar results were found for the Jelenko and Ticonium 18-gauge fully tapered wire and the 20-gauge control wire. However, flexibility was significantly increased for all the fully tapered wrought-wire samples except the 19-gauge Ney PGP. These results suggest that tapering wrought wire improves flexibility. The investigation is continuing in an effort to increase sample size, improve control of the variables, and evaluate the flexibility of tapered wrought wire cast to base metal.

No. 14
MUSCLE STRENGTH RELATED TO THE USE OF AN INTEROCCLUSAL SPLINT

M. W. Parker

The use of interocclusal acrylic splints is purported to improve muscle strength and athletic performance, but the evidence supporting such claims is primarily anecdotal and subjective. This study was undertaken to assess the effect of two interocclusal splints on the strength of the arm adductor muscles and the quadriceps muscles in 10 subjects having no signs, symptoms, or history of myofascial pain dysfunction syndrome, temporomandibular joint dysfunction, or posterior bite collapse. An isokinetic dynamometer was used to measure the strength of a subject's arm adductor muscles over a range of jaw positions. The position associated with the greatest strength was recorded as the optimum jaw position, and a rigid flat plane mandibular splint was fabricated and equilibrated at the optimum position. A resilient vinyl mandibular splint with an arbitrary thickness and a placebo splint that permitted unrestricted closure to centric occlusion also were made for each subject. The strength of a subject's arm adductor and quadriceps muscles with each of the three splints was measured on the dynamometer and the measurements were compared with baseline values obtained with the subject in centric occlusion to determine changes in strength. Comparisons between mean strength changes with the placebo and the other two splints showed no significant differences ($P > .05$) on the basis of parametric and nonparametric analyses. Within the scope of this study, use of interocclusal splints had no effect on muscle strength.

No. 15
A STUDY OF ARBITRARY MANDIBULAR HINGE AXIS LOCATIONS

J. W. Simpson

The relative ease and quickness of making an arbitrary determination of the mandibular hinge axis has led to its ready acceptance. However, studies comparing the various arbitrary hinge axis points to the kinematically located hinge axis show considerable variation as to the arbitrary point that most closely and consistently approximates the kinematic axis. The purpose of this study was to quantitatively compare arbitrary hinge axis locations described by Beyron, Gysi, Bergstrom, and Teteruck and Lundeen, and a point selected by the author to the kinematically located axis. Twenty-eight human subjects with functionally acceptable occlusions and no clinical signs of TMJ disorder were evaluated. Measurements for the five arbitrary points were made with an Almore mandibular hinge axis locator in conjunction with the eyeglass-type flag holders from the TMJ articulator assembly. The kinematic hinge axis was located according to the method suggested by Lauritzen and Bodner. Preliminary results show significant differences between the arbitrary point selected by this investigator and those of Beyron, Gysi, and Bergstrom in relation to the number of points within 5 mm of the kinematic axis and the distance of all points away from the kinematic axis. The study is continuing in an effort to validate these findings.

No. 16
A COMPARISON OF SONIC AND HAND INSTRUMENTATION USING
HISTOLOGY AND SCANNING ELECTRON MICROSCOPY

K. H. Vance

The purpose of this study was to compare morphologically, with scanning electron microscopy, the root surfaces of periodontally diseased human teeth instrumented with hand curets to those instrumented with a sonic scaler instrument. Comparisons were also made histologically on the contiguous soft tissue. Two groups of 11 teeth each were instrumented circumferentially to the bottom of the clinical pocket with either sharp Gracey hand curets or a sonic scaler instrument. The teeth were then extracted and a gingival biopsy was taken. The teeth were prepared for critical-point drying with CO₂ and coated with gold by an evaporation technique. The specimens were examined under a scanning electron microscope for removal of accretions and presence of gouges or scratches on the root surfaces. The biopsies were prepared for histologic evaluation and stained with either hematoxylin and eosin or Mallory's trichrome. The sections were then examined at a magnification of 10X for the presence or absence of residual pocket epithelium and foreign bodies implanted into soft tissue. Preliminary evaluation of eight surfaces of four specimens has shown that none of the surfaces examined was totally free of accretions. The mesial surfaces appear to be more free of accretions than the distal surfaces. Preparation and staining of all specimens has been completed, and the evaluations will be continued during the next year.

No. 17
A COMPARISON OF VENTING AND DIE-RELIEF TECHNIQUES
ON THE RETENTION OF COMPLETE POSTERIOR CROWNS

J. S. Yorty

Improved marginal seal and retention can be obtained by proper seating of full-coverage dental castings on cementation. Two of the most popular methods for achieving this goal are to provide a vent in the casting for escape of cement or to provide internal relief for cement by using a die spacer material. To date, no study has been reported that directly compares the retention of vented castings with the retention of die-relieved castings on cementation. The purpose of this study was to examine the retention provided by each method. Ten extracted human molars were prepared for full-coverage castings and embedded in acrylic resin blocks. An impression was made, three dies were poured, and three crowns cast for each sample tooth. The first casting was vented, the second was fabricated by a die-relief technique, and the third was neither vented nor die relieved (control). Each casting was examined for accuracy of marginal fit with a measuring microscope. A casting was randomly selected for cementation on its sample tooth and removed after 24 hours. The force necessary to unseat this casting was determined with a Chatillon compression testing machine. The two other castings were similarly tested. Preliminary findings suggest that both internal relief for cement and a vent for escape of cement provided for increased retention. However, considerable variation was found for the retention measurements, which indicates that either the sample size should be increased or that further standardization of techniques should be attempted to control the variables.

ABSTRACTS OF SECOND-YEAR REPORTS

No. 1

IMMUNE COMPLEXES IN SERUM AND GINGIVAL CREVICULAR FLUID FROM PATIENTS WITH PERIODONTAL DISEASE

G. G. Cook

Circulating immune complexes are indicators of disease activity in a variety of systemic diseases, but whether they are indicators of periodontal disease activity is not clear. The purpose of this investigation was to examine the serum and gingival crevicular fluid (GCF) from patients with periodontal disease for soluble immune complexes using a recently developed combined solid-phase Clq/enzyme-linked immunosorbent assay (ELISA). Twenty-four patients were selected and placed into a control group, a chronic inflammatory periodontal disease group, or a necrotizing ulcerative gingivitis group based on a clinical examination utilizing subjective periodontal indices. All patients had 10 ml of blood drawn and GCF samples collected with filter paper strips. When the serum and GCF samples were assayed for soluble immune complexes, no significant differences ($P > .05$) were found between the means of the control and the diseased groups. The combined solid-phase Clq with ELISA was found to be a sensitive and accurate method for quantitatively measuring soluble immune complexes.

No. 2

AN EVALUATION OF THE SEALING ABILITY OF COPAL VARNISH IN FULL-CROWN CEMENTATION USING AN AUTORADIOGRAPHIC MODEL

A. F. Creal

The purpose of this study was to examine the physical effectiveness of copal varnish as a sealer against the hydrostatic pressures on cementation of nonvented, die-relieved crowns with a long beveled margin. Twenty extracted human posterior teeth were prepared for full cast restorations. Dies were fabricated from tube impressions and relieved with four coats of commercially available die relief material. Full coverage copings were cast in nonprecious alloy. Three coats of copal varnish were applied to the dried surfaces of 13 of the teeth just before crown cementation. Seven of the teeth not treated with the varnish served as controls. All copings were cemented with zinc phosphate cement mixed in accordance with the manufacturer's directions. The cement was labeled with ^{14}C -glucose or ^{14}C -galactose. The teeth with cemented crowns were serially sectioned and placed on an autoradiographic film for 4-19 days' exposure. Leakage through the varnish membranes was determined by pulpal ingression of the radioisotope below the cement/dentin interface. Results demonstrated leakage in all the teeth but one, including six treated teeth in which the crowns were vented. These findings indicate that the barrier afforded by copal varnish is not effective in preventing cement ingression with hydrostatic pressures experienced in full-crown cementation.

No. 3
A LABORATORY STUDY ON THE EFFECT OF SELF-THREADING
DENTAL PIN DIAMETERS AND CHANNEL LOCATIONS
ON DENTAL DEFECTS

J. S. Durkowski

An area of concern to the restorative dentist is the crazing of enamel that may result from the placement of self-threading pins. The purpose of this study was to determine what effect pin diameter and distance from the cemento-enamel junction have on enamel crazing. Thread-Mate-System self-threading Regular, Minim, Minikin, and Minuta pins were evaluated. Recently extracted human teeth were stained with silver nitrate solution before the crowns were sectioned 1.5 mm coronal to the cemento-enamel junction to detect baseline crazing of enamel. Pin channels were drilled in dentin at 0, 1, 2, or 3 drill diameters from the dentino-enamel junction toward the center with the corresponding drills for each of the above pins. Each sample was stained with methylene blue dye to detect crazing after drilling and then stained with phenol red dye to detect crazing after pin insertion. Four groups of 20 teeth each (4 pins per tooth) were tested, for a total of 320 pins. Crazing was evaluated with respect to pin channel drilling and number of drill diameters from the dentino-enamel junction. No enamel crazing was noted after any of the pin channels had been drilled. Regular pins produced significantly more crazing at drill diameter positions 0, 1, and 2 than the three other pins. Regular pins also produced more pulpal penetrations at drill diameter positions 2 and 3 than the other pin types. These findings suggest that Regular pins have a greater potential for producing enamel crazing and pulpal penetration than the other pins studied. The Minim and Minikin pins produced fewer cracks at drill diameter positions 2 and 3 than at drill diameter position 1.

No. 4
THE SOFT-TISSUE RESPONSE IN RABBITS
TO CHEMICALLY AND BIOLOGICALLY ALTERED HUMAN CALCULUS

P. J. Durso

This study was undertaken to compare the vascular and cellular responses of rabbits to human calculus treated with a variety of chemical and biological substances. Human supragingival and subgingival calculus was treated with phenol, citric acid, sodium deoxycholate at pH 12, sodium deoxycholate with human plasma fraction Cohn IV₁, and sodium deoxycholate with fresh citrated human plasma. Five rabbits were closely clipped to remove all hair from the dorsal aspect of their backs. Each rabbit was perfused with Evans blue dye and injected intradermally with saline-reconstituted, treated calculus specimens. The wheals were measured at 15 minutes, 1 hour, 24 hours, and 1 week. Three animals were sacrificed at 24 hours and two at 1 week. Tissue was recovered from the injection sites and submitted for histological examination. Wheal measurements made at 15 minutes, 1 hour, and 24 hours were compared statistically in an analysis of variance, and no significant differences were noted. The 1-hour measurements were used to evaluate the efficacy of the different treatment modalities. When treated specimens were compared with untreated calculus, it was found that phenol, sodium deoxycholate at pH 12, and sodium deoxycholate with citrated human plasma significantly reduced the intensity of alteration in capillary permeability in the skin of rabbits.

No. 5
INVESTIGATION OF THE MARGINAL OPENING OF SINGLE
AND TWIN PLATINUM-FOIL-BONDED ALUMINOUS PORCELAIN CROWNS

T. W. Faull

Two of dentistry's more recent restorations are the twin and single foil-bonded aluminous porcelain crowns. The twin foil involves two platinum matrixes laid down one over the other. The outer foil is cut short at the axiokingival line angle, tin plated, and oxidized to achieve bonding to the core porcelain. Upon completion, the inner foil is stripped out to provide space for cement and a porcelain-to-tooth butt joint. The single foil technique utilizes a platinum matrix that is bonded to the core porcelain and trimmed flush with the margin before cementation. The purpose of this study was to investigate the marginal opening of these two restorations. The study was divided into two parts. In part one, twin and single foil crowns were fabricated indirectly for extracted human teeth according to the techniques of McLean and Hunt respectively. The crowns were cemented with zinc phosphate cement, embedded in plastic, and sectioned at two points in a faciolingual plane, producing four surfaces for investigation. The facial and lingual margins were measured directly with a measuring microscope. Four crowns were examined for each technique. In part two, five each of the twin and single foil crowns were fabricated directly on typodont teeth to eliminate the variables of impression making and die fabrication. The crowns were embedded, sectioned, and examined as in part one. The mean marginal openings of the crowns fabricated indirectly in part one were: twin foil $74 \pm 36\mu$ and single foil $41 \pm 29\mu$. The Student t test showed no significant difference between the two groups. The mean marginal openings of the crowns fabricated directly in part two were: twin foil $83 \pm 13\mu$ and single foil $64 \pm 13\mu$. These values were significantly different at a probability level of 0.05.

No. 6
AN EVALUATION OF GLUTARALDEHYDE SOLUTIONS
FOR THE DECONTAMINATION OF GUTTA-PERCHA CONES

R. J. Frank

In the effort to maintain the chain of asepsis, cold sterilizing methods rather than physical means have been used to prevent damage to gutta-percha cones. However, there are few substances available that qualify as sterilizing agents. The purpose of this study was to evaluate the effectiveness of two preparations of alkaline glutaraldehyde (Sporicidin and Cidex 7) and 5.25-percent aqueous sodium hypochlorite in sterilizing gutta-percha cones. Gutta-percha cones artificially contaminated with about 400,000 Bacillus subtilis spores were immersed in a saline control solution or one of the three test solutions for 1, 5, or 15 minutes. Microbial assays were then made to determine the number of recoverable colony-forming units left on the cones. Microbial recoveries from cones exposed to each test solution were compared with those of cones exposed to the saline control. Percentages of reductions were calculated from these recoveries. Appropriate controls were included in the study to validate the evaluation procedure. All three disinfectants effectively reduced the number of spores: Sodium hypochlorite sterilized after 1 minute, Sporicidin sterilized after 5 minutes, and Cidex 7 reduced the contamination level by

99.9 percent after 15 minutes. On the basis of this study, sodium hypochlorite appears to be the solution of choice for sterilizing gutta-percha cones. It is fast, convenient, and inexpensive. However, the findings also suggest that Sporidicin may serve as an acceptable alternative.

No. 7
THE EFFECTS OF COOLING ON WORKING TIME AND
EXPANSION OF A HIGH-HEAT INVESTMENT

J. A. Gloria

The use of base metal alloys requires a high-heat, phosphate-bonded investment. These investments, however, have short working times and inadequate expansion properties that make it difficult to compensate for the casting shrinkage of the nonprecious alloys. The purpose of this study was to evaluate the effect on working time and expansion of cooling component parts of a phosphate-bonded investment, Ceramigold Investment System. Sixty-gram mixes of investment were prepared with (1) all components at room temperature, (2) only the liquid cooled to 7° C, or (3) the liquid, powder, and Vac-U-Vestor cooled to 7° C. The investment mixes were evaluated for working time with a Vicat needle. The percentage of linear expansion was determined by a displacement transducer connected to a signal conditioner and a potentiometer strip-chart recorder. There was a significant increase in working time in the systems in which cooling occurred. Working times were determined as 275 ± 44 seconds for the room-temperature control, 322 ± 43 seconds when only the liquid was cooled, and 515 ± 27 seconds when the powder, liquid, and Vac-U-Vestor were all cooled. The percent linear expansion values were determined as 0.7764 ± 0.1384 for the control, 0.7742 ± 0.1034 when only the liquid was cooled, and 0.5631 ± 0.0943 when all systems were cooled. Comparisons with the control were not significant.

No. 8
AN ASSESSMENT OF A FIXED SET OF DESCRIPTORS
USED FOR THE DIAGNOSIS OF PAIN
IN A HOSPITAL DENTAL SERVICE POPULATION

E. H. Hall

Despite rapid advances in both medicine and dentistry, the diagnosis of pain remains one of the most challenging and inexact areas of clinical endeavor. Recently, Melzack and Wall proposed the "gate control theory" of pain, which suggests that pain is actually a composite of several emotional responses, such as fear, anger, and concern. On the basis of this theory, the McGill Pain Questionnaire was developed, and it proved sensitive enough to discriminate among various types of pain. The purpose of this study was to evaluate the McGill Pain Questionnaire for sensitivity in differentiating among pain-producing syndromes commonly seen by the dentist. One hundred and five patients with pain as a chief complaint were evaluated with the McGill Pain Questionnaire. There were 81 men and 24 women, ranging in age from 15 to 77 years. Patients were grouped into three broad categories according to the origin of the pain: pain of periodontal origin, pain of pulpal origin, and TMJ pain. The descriptive pain words that the patient selected from the 20 McGill subclasses were recorded and compared to the category of pain. There were marked differences in the

descriptors used in each of the three broad categories of pain. Although the results indicate certain trends, a larger sample base is needed for statistical analysis and to permit development of descriptor patterns unique for individual pain syndromes that the dentist frequently encounters. This study is continuing in an attempt to confirm these initial results.

No. 9

ROOT SURFACE AREA OF THE MAXILLARY FIRST MOLAR

D. W. Hermann

This study tested the assumption that the palatal (PAL) root of maxillary molars has significantly greater attachment area than either the mesiobuccal (MB) or the distobuccal (DB) roots by documenting the root surface area of the individual roots and root trunks of 20 maxillary first molars. Each previously extracted molar was invested in acrylic and cross-sectioned every millimeter at a right angle to the long axis of the tooth. Ektachrome transparencies were taken of the coronal and apical sides of the sections and projected on a fixed screen at a magnification of approximately 50X. The circumference of each projected root and root trunk section was measured with a calibrated opisometer. Mean circumferential measurements from each 1-mm section were summed to give the surface area for each root and root trunk. The surface areas were $91.22 \pm 16.67 \text{ mm}^2$ for the DB root, $117.74 \pm 23.32 \text{ mm}^2$ for the MB root, $114.52 \pm 22.01 \text{ mm}^2$ for the PAL root, and $152.95 \pm 32.71 \text{ mm}^2$ for the root trunk. Statistical comparisons were made with the Student t test. The results showed that the DB root had significantly less surface area than either the MB or PAL roots or the root trunk ($P < .01$). There was no significant difference between the surface areas of the MB and PAL roots ($P > .05$). The surface area of the root trunk, as measured from the CEJ to the roof of the furcation, was significantly greater than that of any of the three individual roots ($P < .05$).

No. 10

A COMPARATIVE STUDY OF ROOT CANAL FILLING WITH THE
McSPADDEN COMPACTOR AND LATERAL CONDENSATION
BY SCANNING ELECTRON MICROSCOPY

A. V. Hill, Jr.

The ability of gutta-percha to reach a plastic state, increasing its flow property, return to a solid state, and remain dimensionally stable has led to the development of many techniques using warm (thermally plasticized) gutta-percha. McSpadden recently introduced a technique known as thermatic compaction, which uses warm gutta-percha. The technique employs a calibrated stainless steel endodontic instrument called the McSpadden compactor that fits on a conventional slow-speed handpiece. The purpose of this study was to evaluate the thermatic compaction technique for homogeneity and adaptation of the gutta-percha to dentin walls by means of scanning electron microscopy. Root canals filled by the McSpadden technique were compared with canals filled by the lateral condensation technique. Twenty-four teeth with single canals were prepared for obturation and filled with gutta-percha. Eight canals were obturated by lateral condensation, eight by the McSpadden technique with sealer, and eight by the McSpadden technique without sealer. Representative composite

microphotographs of the entire root canal of two sectioned teeth from each of the three filling techniques were subjectively evaluated and compared by 10 separate examiners for adaptation of the gutta-percha to the surrounding dentinal walls and for homogeneity of the filling material. The results suggest that in a single straight canal the McSpadden technique with and without sealer produces fillings that are more closely adapted and homogeneous than those produced with the lateral condensation technique.

No. 11

THE EFFECT OF VIBRATION ON CROWN CEMENTATION
WITH AND WITHOUT DIE RELIEF

B. B. Hoffman

The degree of residual margin opening of cast full veneer crowns after final cementation directly affects the rate of cement dissolution and disintegration. Die relief is an easy and accepted method for improving crown seating. Vibration has been proved to reduce the effective viscosity of cement films to flow. The purpose of this study was to examine the effect of vibration on the cementation of castings made with and without die relief. Two gold castings were made to fit a machined steel die, one with an exact fit and the other slightly oversized. Three gold castings were made on an identical die covered with a 25 μ layer of die spacer. One of the die-relieved castings contained an occlusal vent and served as the control. Experimental castings were cemented five times with and without vibration for a total of 40 cementations. The control casting was cemented five times without vibration. Precementation and postcementation measurements were compared for degree of vertical opening. The results demonstrated that precisely fitted crowns always failed to seat within clinical standards. Vibration significantly reduced the degree of vertical opening for all groups tested. The control casting produced a mean opening of 16 μ . Oversized and die-relieved castings produced margin openings of 19 μ and 22 μ when cemented with vibration; these measurements were not significantly different from the control. Without vibration, only die-relieved castings were able to be cemented within the clinically acceptable range of 39 μ .

No. 12

A FEASIBILITY STUDY: THE USE OF PULPAL
NERVE TISSUE AS A BIOPSY SPECIMEN FOR THE DIAGNOSIS OF
PERIPHERAL NEUROLOGICAL DISORDERS

J. W. Hutter

Despite extreme patient discomfort and the possibility of postoperative complications, the sural nerve at the ankle level is commonly used as the biopsy specimen for diagnosing peripheral neurological disorders. A two-phase study was undertaken to evaluate the feasibility of using pulpal tissue as a biopsy specimen. In the first phase of the study, normal pulp tissue obtained from eight freshly extracted teeth was fixed in formalin; embedded in paraffin; sectioned; stained with hematoxylin and eosin, Bodian silver, luxol-fast blue, and Masson trichrome; and examined under the light microscope to ascertain the quantity and quality of myelinated nerve tissue present. Nerve fibers were

found in all the sections studied. However, they were not arranged into multiple fascicles with associated epineurial and perineurial nerve sheaths. In the second phase of the study, normal pulp samples were subjected to a series of steps of osmication, dehydration, and infiltration with Epon 812. Upon polymerization, the samples were cut into thick sections that were stained with methylene blue and examined with the light microscope to orient the cutting of the thin sections. Once cut, the thin sections were stained with lead citrate and uranyl acetate and examined under the electron microscope. Multiple fascicles of myelinated nerve fibers were observed, and the repeating units of the myelin sheath were clearly defined. Although pulpal nerve tissue cannot be subjected to all the diagnostic tests performed on the sural nerve, the findings indicate that pulpal nerve tissue may be a viable specimen for diagnosing peripheral neuropathies that affect the nerve fiber itself.

No. 13

AN IN VITRO STUDY OF CERTAIN PHYSICAL PROPERTIES OF A NEW RESIN RESTORATIVE MATERIAL

J. M. Kelly

Since the introduction of the composite resins as an alternative to the unfilled methyl methacrylate resins, there has been a trend toward formulating materials that would develop and maintain a smoother and more durable surface. Miradapt, a hybrid resin restorative material with both 4 μ -20 μ barium glass and submicron silica particles, has been introduced as a material that shows an improvement on the surface finish of conventional composites without loss of durability. The purpose of this study was to evaluate Miradapt for water sorption, hardness, and abrasion resistance. Comparisons were made with an unfilled resin (Sevriton), a conventional composite resin (Concise), and a microfilled resin (Silar). Three samples of each material were tested according to procedures outlined in ADA Specification No. 27 for 7-day water sorption. The same samples were then tested for hardness with a Rockwell Superficial Hardness Tester. Wear studies were carried out on a computer-controlled pin and revolving disk apparatus. Water sorption values for Miradapt were significantly lower than those for Sevriton and Silar, but significantly higher than those for Concise. Miradapt was the hardest of the four materials and was found to have abrasion resistance comparable to the conventional composites and significantly superior to the microfilled resin.

No. 14

AN INVESTIGATION OF THE FLEXURE STRENGTH OF CARBON-FIBER-REINFORCED COMPOSITE RESTORATIVE RESINS

B. M. Kilfoil

Recent studies in the field of synthetic resins have shown that there is a qualitative improvement in the physical properties of epoxies and acrylics when they are reinforced with linear carbon fibers. If carbon fibers added to composite resins demonstrate improved resistance to fracture, some of the shortcomings of the acid-etched provisional fixed partial denture technique might be eliminated. The purpose of this study was to compare the flexure strength of

carbon-fiber-reinforced composite resins mechanically interlocked with simulated acrylic resin denture teeth with that of unmodified composite resin. Fifty simulated anterior fixed bridge pontics were constructed of clear acrylic resin and trued to dimensional accuracy. A transverse groove 3.5 mm by 1 mm was machined in each block with a one-eighth-inch carbide cutter. An aluminum jig was used in the machining process to ensure uniformity. In a separate procedure, the groove was undercut using a No. 37 inverted cone bur modified to cut only on its circumference. The edge of the milled groove served as a guide for the modified bur. Bars of composite resin were added to a transverse groove cut in the block and extending laterally on each side. The bar portions of the samples were modified by the addition of 0.001 g of carbon fibers to 10 samples, 0.005 g to 10 samples, and 0.035 g to 8 samples. The test samples were compared with 13 control samples that contained no carbon fibers. After they were thermocycled, the samples were tested to fracture on an Instron universal testing machine. The groups with 0.005 g and 0.035 g of carbon fibers added produced significantly lower flexure strength values than the controls. These results suggest that carbon fibers added to composite resin decrease rather than increase the flexural strength of the material.

No. 15
THE EFFECT OF FLUORIDE ETCHANTS ON THE
COMPOSITE RESIN-ENAMEL BOND

G. J. Kvaska

The use of fluoride in restorative systems has been considered an additional means of combating recurrent caries. Incorporation of fluoride in acid-etch solutions increases fluoride concentration in enamel and may help to reduce recurrent caries at the margins of composite resin restorations. The use of fluoride, however, would be acceptable only if the bonding strength and the marginal integrity of the restoration were not compromised. The purpose of this study was to evaluate the effect of fluoride etchants on the composite resin-enamel bond. Forty bovine teeth were treated with different acid etchants: 37-percent H_3PO_4 alone (control), 0.5-percent NaF and 0.5-percent SnF_2 in 37-percent H_3PO_4 , and 2-percent NaF and 37-percent H_3PO_4 . A method was devised to use the same tooth for the different etchants. Composite resin was bonded to each surface etched, and an Instron universal testing machine was used to determine the load necessary to fracture the bond. Half of the teeth were tested 24 hours after treatment, the other half 3 weeks after treatment. The results showed that there was no significant difference in composite resin-enamel bond strength between the control surfaces and the surfaces prepared with the fluoride etchants at either test period. These findings indicate that the composite resin-enamel bond is not affected by the addition of fluoride to the etchant solution in the concentrations tested.

No. 16
THE LOCATION OF THE CELLULAR COMPONENT OF
PERIOSTEUM IN MUCOPERIOSTEAL FLAPS IN MONKEYS

J. B. Sandifer

New connective tissue attachment following a full-thickness laterally positioned flap may be due to the osteogenic potential of the cambium layer of the periosteum. The purpose of this study was to determine the location of the cambium layer and the thickness of the periosteum after the elevation of a full-thickness flap. Full-thickness flaps, 5 by 5 mm, were elevated and excised in the right maxillary canine-lateral incisor area of six rhesus monkeys. The underlying bone was then removed. Control specimens of intact block sections of gingiva and underlying bone were obtained from contralateral sites. After fixation, the specimens were decalcified and processed for routine histologic examination. The width of the periosteum and the number of cells per millimeter adjacent to the bone were determined with a stage micrometer. The tissues of the control specimens were compatible with mature periosteum. The difference between the mean width of the control periosteum and that of the periosteal tissue elevated with the flap was not significant. The number of cells per millimeter adjacent to the bone in the intact periosteum was 16.6 ± 4.8 . After the flap was elevated, the number of cells on the osseous surface was $2.3 \pm 1.1/\text{mm}$. Because of the significant difference between the two values, it appeared that most of the cells were either elevated with the flap or destroyed. In some sections, a thin layer of osteoid material was elevated with the flap. The findings suggest that the total width of the fibrous periosteum is elevated with the full-thickness flap. However, the fate of the cambium layer could not be demonstrated in these procedures.

No. 17
THE CASTING ACCURACY OF CERAMOMETAL ALLOY
CASTINGS MADE ON DIVESTMENT DIES

P. E. Schmid

It has been shown that gold castings made with the Divestment die-investing technique have a discrepancy of fit about half that of castings in which the wax patterns were removed from the dies before investing. A modification of the Divestment technique has been proposed to permit castings to be fabricated of the higher-melting-temperature ceramometal alloys. The purpose of this study was to evaluate the marginal fit of full veneer castings of ceramometal alloys using a die-investing technique. The controls consisted of castings of a Type III gold alloy made from a standard die following the conventional Divestment technique and also the modified Divestment technique. The control castings were compared to castings of Cameo, Jelenko "O," Olympia, and Pentillium alloys fabricated by the modified Divestment technique. The control and experimental groups consisted of five castings each. Measurements of marginal openings were made with a measuring microscope at four places on each casting after it was seated on the master die. The results showed that in a cross comparison of marginal openings, all of the castings except those of the Cameo alloy demonstrated a significant variance from the control. The marginal discrepancy of the Cameo castings fabricated by this technique did not differ significantly from that of Type III castings fabricated by the standard Divestment technique. The modified Divestment technique, therefore, might be valuable for producing Cameo ceramometal castings with a marginal accuracy superior to that of castings fabricated with the standard Divestment technique.

ABSTRACT OF THIRD-YEAR REPORT

No. 1

AN EVALUATION OF THE POTENTIAL IRRITATION OF OCULAR TISSUE OF RABBITS BY IRREVERSIBLE HYDROCOLLOIDS

E. M. Fraleigh

Four alginate materials (Mold-Eye Ophthalmic, Ophthalmic Moldite, Kerr Type II Dental, Jelset Type II dental) were evaluated histologically for their possible inflammatory response in the ocular mucosal membrane (conjunctiva) of rabbits. Forty healthy adult rabbits were divided into four equal groups of mixed sex, a 10-animal group for each alginate material tested. Each rabbit in a group had its left eye impressed with two 4-minute applications of the alginate material, which was mixed according to the manufacturer's recommendations for water-powder ratio, mixing time, and water temperature. The animal's right eye served as a control. Thirty minutes after the second impression, the animal was killed and both eyes were exenterated by block dissection, blind coded, and prepared for histologic examination. Prepared tissue sections were evaluated by two independent pathologists and graded for the presence or absence of acute inflammatory response. The tissue responses were statistically analyzed for significance with chi square analysis at a probability level of $\leq .01$. Each material tested elicited varying degrees of acute inflammatory response. The statistical implication is that the ophthalmic alginates produced a slightly lower level of inflammatory response.

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<p>These abstracts provide a synopsis of research projects conducted by dental officers enrolled in the first-, second-, and third-year residency programs at the National Naval Dental Center, Bethesda, Maryland, during the academic year of 1981-1982. The projects were completed in partial fulfillment of the requirements of the programs.</p>												

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